CORRECTED VERSION

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 057PCT0464	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2005/003475	International filing date *(day/month/year)* 29.03.2005	Priority date *(day/month/year)* 30.03.2004

International Patent Classification (IPC) or national classification and IPC
INV. H01M8/02

Applicant
REINZ-DICHTUNGS-GMBH et al.

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 1-4 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in celectronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
28.10.2005	06.03.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Wiedemann, E Telephone No. +49 89 2399-7542

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2005/003475

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-25	as originally filed
Claims, Numbers	
1-17	received on 30.01.2006 with letter of 30.01.2006
Drawings, Sheets	
1/4-4/4	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2005/003475

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (SEPARATE SHEET)

International application No.
PCT/EP2005/003475

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US 2003/124405 A1 (ROCK JEFFREY A) 3 July 2003 (2003-07-03)
D2: US 2002/064702 A1 (GIBB PETER R) 30 May 2002 (2002-05-30)
D3: DE 101 62 871 A1 (FORSCHUNGSZENTRUM JUELICH GMBH) 10 July 2003 (2003-07-10)
D4: US 2003/194595 A1 (GIBB PETER R ET AL) 16 October 2003 (2003-10-16)
D5: US-A-5 863 671 (SPEAR, JR. ET AL) 26 January 1999 (1999-01-26)

2. Amendments

The subject-matter of the amendments filed with the letter dated 30.01.2006 are considered to fulfill the requirements of Article 34 (2) PCT.
The basis of the wording introduced "...whereas the channel structure...to a second channel (7.2)..." is based on the description pages 7 and 21, lines 24ff and 21ff respectively.

3. Novelty

The subject-matter of claims 1-17 is considered to be novel, Article 33 (1) and (2) PCT.
Documents D1 and D2 discloses bipolar plates for use in an electrochemical system. Two plates with different patterns (channels, projections, etc.) are provided and arranged together to form in their middle a cooling flow field and on the opposite sites oxygen and fuel flow fields respectively. Some patterns also form cross over sections from one channel of the first plate to a second channel on the second plate. The disclosed grooves are either of serpentine or straight shape. The bipolar plates are normally made of steel, wherein the projections stamped on the plates can be of the same or of different height.

Document D3 discloses bipolar plates a first has projections and a second having a flat surface. Consequently, this pattern does not provide separated channels on one plate wherein cross over of the fuel is realized by projections from the opposite plate.

None of the available documents discloses a first bipolar plate with a groove pattern of unconnected grooves in which the opposite second bipolar plate comprises discrete

projections corresponding to the opposing channel structures and to use them as cross over elements.

Therefore, the bipolar plate, its manufacturing process and the electrochemical system which comprises at least on of these bipolar plates (claims 1, 13 and 14) are considered to be novel.

4. Inventive step

The subject-matter of claim 1-17 is considered to be based on an inventive step, Article 33 (3) PCT.

4.1 It is agreed to regard document D3 as closest prior art.

4.2 The technical problem underlying the present application is considered to provide a new pattern for the cooling channels in a bipolar plate which is easy to assemble.

4.3 This problem is known in the prior art but solved differently.
None of the available documents discloses a first bipolar plate with a groove pattern of unconnected grooves in which the opposite second bipolar plate comprises discrete projections corresponding to the opposing channel structures and to use them as cross over elements.
The advantage can be seen in achieving a complex flow structure with good heat distracting characteristics by assembling two structures easy to manufacture.

5. Industrial applicability

The subject-matter of the present application is industrially applicable in the field of bipolar plate manufacture.

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REINZ-Dichtungs-GmbH

Amended Claims

1. A bipolar plate (1) for electrochemical systems, which contains a first plate (2) with a first flowfield (2a) for media distribution as well as a second plate (3) with a second flowfield (3a) for media distribution, wherein the first plate in the region of the first flowfield at least in regions has a plane surface section (4) from which discrete projections (5) distanced to one another and arranged in a distributed manner project, characterised in that the second plate comprises channel structures (7), and the projections (5) on the first plate as well as the channel structures (7) on the second plate (3) are arranged in a manner such that a cavity (8) for introducing cooling fluid is formed between the first (2) and the second (3) plate, whereas the channel structure on the second plate (3) comprises a first channel (7.1) which is unconnected to a second channel (7.2), and the projections (5) on the first plate (2) and the corresponding channel structures (7) on the second plate (3) are designed such that the projections (5) form a cross-over of cooling fluid from a first channel (7.1) of the channel structure to a second channel (7.2) of the channel structure.

2. A bipolar plate according to claim 1, characterised in that at least the first plate (2) comprises projections (5) for distributing a fuel medium on the anode side (6.1a) of a fuel

cell (6.1), and the second plate (3) of the bipolar plate (1) is designed for distributing media such as for example air or oxygen on the cathode side (6.2) of the bipolar plate (1).

3. A bipolar plate according to one of the preceding claims, characterised in that the second plate (3) comprises channel structures (7), wherein these at least in regions are designed linearly and/or groove-like and/or the second plate likewise comprises discrete projections distanced to one another.

4. A bipolar plate according to claim 3, characterised in that the channel structures (7) are designed as straight-lined channels lying next to one another.

5. A bipolar plate according to one of the claims 3 or 4, characterised in that the channel structures (7) have height differences.

6. A bipolar plate according to one of the preceding claims, characterised in that the projections are C-, I-, U-, L-, H-, X-, V-, O-shaped (Fig. 2)

7. A bipolar plate according to one of the preceding claims, characterised in that the projections (5) have a height of 0.3 to 0.7 mm, preferably 0.4 to 0.6 mm with respect to the plane surface section (4).

8. A bipolar plate according to one of the preceding claims, characterised in that the projections (5) have height differences.

9. A bipolar plate according to one of the preceding claims, characterised in that the projections (5) on the first plate (2) and the corresponding channel structures (7) on the second plate (3) are designed such that one (8.1) or several (8.1, 8.2) cooling circuits are formed in the cavity for introducing cooling fluid.

10. A bipolar plate according to one of the preceding claims, characterised in that this is of a metal such as steel, stainless steel, nickel, aluminium or titanium.

11. A bipolar plate according to one of the preceding claims, characterised in that the bipolar plate (1) is of sheet steel or stainless steel sheet.

12. A bipolar plate according to one of the preceding claims, characterised in that the material thickness of the first or second plate in each case in their unshaped sections is from 0.05 to 0.6 mm, preferably 0.075 to 0.3 mm.

13. A method for manufacturing a bipolar plate according to one of the preceding claims, characterised in that the first (2) as well as the second (3) plate are provided with projections and/or channel structures by way of roller embossing, punching, hydroforming, eddy current embossing, and subsequently the first and the second plate on the sides opposite to the channel structures and/or projections are joined to one another preferably by way of soldering, bonding or laser beam welding.

14. An electrochemical system (9) containing at least one bipolar plate according to the patent claims 1 to 12.

15. A system according to claim 14, characterised in that this is a polymer electrolyte membrane system with at least one fuel cell (6.1), wherein this at least one fuel cell consists of an electrolyte membrane which preferably has gas diffusion layers on both sides, on whose side distant to the polymer electrolyte membrane, flowfields of at least one bipolar plate (1) are arranged.

16. A system according to claim 15, characterised in that the fuel cell (6.2) on the cathode side (6.2b), with surrounding air, is self-breathing or force ventilated.

17. The use of a plate according to one of the claims 1 to 12 in an electrochemical system such as fuel cell, electrolysers and electrochemical compressors.